

## CLAIMS

I claim:

1. A bi-leaved valve apparatus comprising:
  - a substantially cylindrical flow tube defining an axial material passageway, an outlet and a flow tube actuation surface;
  - a valve support mounted about the flow tube adjacent the flow tube outlet, said valve support and flow tube being relatively rotatable;
  - a pair of leaves attached to the valve support and sized to seal the flow tube outlet, said leaves being movable between open and closed orientations and having a valve actuation surface adjacent the flow tube actuation surface; and
  - an actuator causing relative rotational movement of the flow tube and valve support such that rotation to a first relative position causes the flow tube and valve actuation surfaces to open the leaves and rotation to a second relative position causes the leaves to close.
2. The bi-leaved valve apparatus of claim 1 wherein:
  - the flow tube actuation surface comprises a pair of notches integral with the flow tube;
  - The valve actuation surface comprises a cam member projecting from each leaf into a respective notch; and
  - coaction of the notch and cam member moves a respective leaf during the relative rotation between the positions.
3. The bi-leaved valve apparatus of claim 1 wherein the flow tube is stationary and the valve support rotates relative to the flow tube.
4. The bi-leaved valve apparatus of claim 3 wherein the valve support is mounted for bi-directional rotational movement between the positions.

5. The bi-leaved valve apparatus of claim 1 wherein the valve support defines a valve support opening having a substantially circular cross section transverse to the axial material passageway and the leaves are diametrically connected to the valve support across the valve support opening along a common axis.

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6. The bi-leaved valve apparatus of claim 5 wherein each leaf includes a straight edge and an intersecting arcing edge defining a maximum distance from the straight edge and the leaves form a substantially circular surface across the valve support opening when in the closed position.

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7. The bi-leaved valve apparatus of claim 6 wherein the leaves partially overlap adjacent the straight edges.

8. The bi-leaved valve apparatus of claim 7 wherein one leaf is an outer leaf,  
15 the other leaf is an inner leaf and the straight edge of the outer leaf is in contact with an inner leaf outer surface as the leaves are moved between the open and closed positions.

9. The bi-leaved valve apparatus of claim 6 wherein each leaf includes a pair of axially-aligned stub shafts journaled with respect to the valve support along the single  
20 axis.

10. The bi-leaved valve apparatus of claim 9 wherein one of each pair of axially-aligned stub shafts has a female end journaled directly in the valve support and the other of each pair of axially-aligned stub shafts has a male end journaled in the  
25 female end.

11. The bi-leaved valve apparatus of claim 1 wherein the actuator comprises:
- an actuator mount;
  - a linear actuator having a body affixed to the actuator mount and a piston;
  - 5 • a linkage connecting the piston and valve support such that movement of the piston rotates the valve support relative to the flow tube; and
  - a controller operatively controlling operation of the linear actuator.

12. The bi-leaved valve apparatus of claim 11 wherein the linear actuator is a  
10 pneumatic actuator.

13. The bi-leaved valve apparatus of claim 11 wherein the linear actuator provides bi-directional movement to the piston.

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14. A bi-leaved valve apparatus comprising:

- a stationary substantially cylindrical flow tube defining an axial material passageway, a flow tube outlet and at least one flow tube actuation surface;
- 5       • a substantially cylindrical valve support mounted concentrically about the flow tube adjacent the flow tube outlet, said valve support being rotatable relative to the flow tube;
- a pair of substantially D-shaped leaves pivotally connected to the valve support across the flow tube outlet along a common axis transverse to
- 10       the axial material passageway, each leaf including an actuation surface positionable against the flow tube actuation surface; and
- an actuator in power-transmission relationship with the valve support, said actuator rotating the valve support relative to the flow tube such
- 15       that, in one relative position, coaction of the flow tube and valve actuation surfaces urges the leaves to an open position and, in a second position, coaction of the flow tube and valve actuation surfaces urge the leaves to a closed position sealing the flow tube outlet.

20       15. The bi-leaved valve apparatus of claim 14 wherein the flow tube actuation surface comprises a pair of notches integral with the flow tube outlet.

16. The bi-leaved valve apparatus of claim 14 wherein the valve support is mounted for bi-directional rotational movement between the positions.

25       17. The bi-leaved valve apparatus of claim 14 wherein each leaf includes a straight edge and an intersecting arcing edge and the leaves form a circular surface across the valve support opening when in the closed position.

30       18. The bi-leaved valve apparatus of claim 17 wherein the leaves partially overlap adjacent the straight edges.

19. The bi-leaved valve apparatus of claim 18 wherein one leaf is an outer leaf, the other leaf is an inner leaf and the straight edge of the outer leaf is in contact with an inner leaf outer surface as the leaves are moved between the open and closed positions.

5           20. The bi-leaved valve apparatus of claim 14 wherein each leaf includes a pair of axially-aligned stub shafts journaled with respect to the valve support along the common axis diametrical to the valve support opening.

10           21. The bi-leaved valve apparatus of claim 14 wherein the actuator comprises:

- an actuator mount;
- a bi-directional linear actuator having a body affixed to the actuator mount and a piston powered in first and second directions;
- a linkage connecting the piston and valve support such that movement of the piston rotates the valve support; and
- 15       • a controller operatively controlling activation of the bi-directional linear actuator.

22. A bulk material metering apparatus comprising:

- a support structure;
- a feed hopper mounted with respect to the support structure;
- a substantially cylindrical flow tube mounted with respect to the support structure, said flow tube defining an axial material passageway, an upper inlet in material-feed relationship with the feed hopper, a lower outlet and a flow tube actuation surface;
- a substantially cylindrical valve support mounted about the flow tube adjacent the flow tube outlet, said valve support and flow tube being rotatable relative to the other;
- a pair of substantially D-shaped leaves pivotally connected to the valve support across the flow tube outlet along a single axis transverse to the axial material passageway, each leaf having a valve actuation surface positionable along the flow tube actuation surface;
- an actuator causing relative rotational movement of the flow tube and valve support such that rotation to a first relative position causes the actuation surfaces to open the leaves and rotation to a second relative position causes the leaves to close; and
- a controller operatively controlling the drive unit and actuator.

23. The bulk material metering apparatus of claim 22 further comprising vertical form/fill/seal apparatus for packaging predetermined amounts of bulk material including:

- 5           • a packager mounted with respect to the support structure including machine structure adapted to position an open end of a tube-shaped packaging material web in material-feed relationship with the flow tube outlet;
- 10          • a sealer mounted with respect to the support structure including machine structure adapted to form the packaging material web into separate sealed packages containing the bulk material; and
- a separator mounted with respect to the support structure including machine structure adapted to separate the sealed packages from the packaging material web.

15           24. The bulk material metering apparatus of claim 22 wherein:

- the flow tube actuation surface comprises a pair of notches integral with the flow tube;
- The valve actuation surface comprises a cam member projecting into a respective notch; and
- 20          • coaction of the notch and cam member moves a respective leaf during relative rotation between the positions.

25           25. The bulk material metering apparatus of claim 22 wherein the flow tube is stationary and the valve support rotates relative to the flow tube.

26. The bulk material metering apparatus of claim 25 wherein the valve support is mounted for bi-directional rotational movement between the positions.

30           27. The bulk material metering apparatus of claim 22 wherein the valve support defines a valve support opening having a substantially circular cross section transverse to the axial material passageway and the single axis is a valve support opening diameter.

28. The bulk material metering apparatus of claim 27 wherein each leaf includes a straight edge and an intersecting arcing edge defining a maximum distance from the straight edge and the leaves form a circular surface across the valve support opening when in the closed position.

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29. The bulk material metering apparatus of claim 28 wherein the leaves partially overlap adjacent the straight edges when in the closed position.

30. The bi-leaved valve apparatus of claim 29 wherein one leaf is an outer leaf, the other leaf is an inner leaf and the straight edge of the outer leaf is in contact with an inner leaf outer surface as the leaves are moved between the open and closed positions.

31. The bulk material metering apparatus of claim 29 wherein each leaf includes a pair of axially-aligned stub shafts journaled with respect to the valve support along the single axis.

32. The bulk material metering apparatus of claim 31 wherein one of each pair of axially-aligned stub shafts has a female end journaled directly in the valve support and the other of each pair of axially-aligned stub shafts has a male end journaled in the female end.

33. The bulk material metering apparatus of claim 22 wherein the actuator comprises:

- an actuator mount;
- a linear actuator having a body affixed to the actuator mount and a piston; and
- a linkage connecting the piston and valve support such that movement of the piston rotates the valve support relative to the flow tube.

34. The bulk material metering apparatus of claim 33 wherein the linear actuator is a pneumatic actuator.



35. The bulk material metering apparatus of claim 33 wherein the linear actuator provides bi-directional movement to the piston.